2006 RESEARCH PROBLEM STATEMENT

Problem Title: Calibration of AASHTOs New Prestress Loss Design Equations **No.:**06.08-2

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1. Briefly describe the problem to be addressed:

In the next edition of the AASHTO LRFD Bridge Design Specifications the procedure to calculate prestress losses will change dramatically. The new equations are empirically based on high performance concrete from four states (Nebraska, New Hampshire, Texas and Washington). The material testing resulted in modified equations to predict elastic shortening, shrinkage and creep. Because high performance concrete has traditionally resulted in smaller prestress losses these new equations also estimate lower losses in comparison to the existing equations. Many of the bridges built in Utah do not use specifically high performance concrete, but a self consolidating concrete that is different that the mixes that were used to develop the new AASHTO equations. This research is two fold: 1- obtain design parameters elastic modulus(i.e., k_1 and k_2 for the elastic modulus)shrinkage and creep for typical Utah concrete girders mixes and 2- quantify the effects of deck casting and differential shrinkage on prestress gains to be used in the new procedures.

2. List the research objective(s) to be accomplished:

1. Obtain design parameters for elastic modulus for typical Utah prestressed concrete mix designs.
2. Obtain ultimate shrinkage and creep values for typical Utah prestressed concrete mix designs.
3. Provide design recommendations for prestress losses for typical Utah prestressed concrete mix design.
4. Quantify the effects of deck casting, differential shrinkage and camber by instrumenting a typical prestressed concrete bridge.
5. Prepare final report.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Obtain and test various concrete samples from representative precast plants (Eagle precast , Encon and possibly an Idaho plant) for elastic modulus, shrinkage and creep. (680 hours)
2. Analyze data in order to obtain design parameters for elastic modulus (k_1 AND K_2) , shrinkage (ε_{shult})and creep that will be specific for concrete mix designs within the state of Utah. (160 hours)
3. Instrument and monitor a prestressed concrete girder bridge to evaluate stress gains due to deck casting and differential shrinkage. (700 hours)
4. Compare design parameters with in situ results and provide design parameters for elastic shortening, shrinkage, creep, prestress gains due to deck casting and differential shrinkage. (240 hours)
5. Prepare final report (100 hours)
6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Task 1 – 6 to 8 months

Task 2 – 2 months

Task 3 – 12 months

Task 4 – 3 months

Task 5 (report preparation and presentation)- 1.5 months

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative：

☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) The deliverable will be in terms of a of a report or manual of practice that provided specific design values for the calculation of elastic modulus, shrinkage and creep which would be used for the estimation of prestress losses.

8. Describe how will this project be implemented at UDOT.

This research will be implemented at the design stage for the structural engineer. With the new AASHTO design procedures, it is anticipated that engineers will use these results for each prestressed concrete bridge that is designed and built within the state of Utah.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The beneficiaries will ultimately be the tax payers. Over or under predicting prestress losses can affect both the service and ultimate limit states. When bridges are deemed to perform unsatisfactory prior to reaching an adequate design life the replacement cost can be detrimental to a DOT especially with limited budgets. This project will provide design parameters that will enable the engineer to design precast, prestressed concrete bridges that will be exhibit better service performance. This will hopefully improve the service life of the bridges.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The major obstacles will be with obtaining representative samples and a representative bridge. Marv and I have recently spent time at Eagle Precast and have developed a good working relationship with their QC personnel. They seem very willing to work with and our previous experience will be valuable. We also intend to work with Encon Precast and develop similar relationships. We hope that this investment will pay dividends for both UDOT and the specific research project.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Boyd Wheeler or Ray Cook

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $80,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Boyd Wheeler		
B) Ray Cook		
C) Dan Church		
D) Robert Nash		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: Any department of transportation, FHWA or design agency that will design prestressed concrete bridges using the new AASHTO procedures.